25. Further Contributions to the Anatomy of the Ophidia.

By Joseph C. Thompson, Surgeon, U.S. Navy *.

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Methods Employed.

A routine procedure is needed for recording and correlating observations made on the anatomy of serpents. In comparative anatomical studies of mammals, the position of an organ is given in terms of its relation to other viscera. With animals of a compact build this is amply sufficient; with serpents on the other hand, owing to their attenuated bodies, it is not adequate to state that one organ lies posteriorly to another. This drawing out of the body is accompanied by much variation as to the relative lengths of different organs and their distances apart. For example, the tip of the liver may be situated the distance of a dozen vertebræ behind the apex of the heart, with a thick-walled right lung filling the space between them, or it may overlap the apex of the heart by several millimetres, and the lung be a mere air-sac dorsal to the liver. The length of certain organs varies to a degree unknown in any other Order. For example, the right lung may terminate a few millimetres posterior to the end of the liver, or extend nearly to the cloaca.

If the gastrostege level at which the various structures occur is recorded, one may obtain data satisfactory for comparing different species or for determining the range of variation in a series. Take for example the data relating to *Thamnophis ordinoides*: the apex of the heart is recorded as being at the 26th, the anterior tip of the liver at the 70th, and the posterior end at the 86th gastrostege. It may be seen at a glance that the liver is nine gastrosteges posterior to the heart and that it is of a definite length, extending over thirty-five shields †. For comparing series it will be found of advantage to reduce the records to a percentage. In each case the number of gastrosteges in the specimen is to be taken as the base.

Returning to *T. ordinoides*: the number of gastrosteges in an example of that species is 157, and the position of the heart or liver in terms of its distance down the spinal column is as follows:—Heart apex 16·6 per cent.; liver tip 22·3 per cent.; liver end 44·6 per cent. Behind the posterior pair of geneials there are usually one or two pairs of small gular shields; these are followed by from one to three shields in the median line which increase in width in pyramidal fashion. The shield regarded as the first gastrostege is the one that is nearly the standard width; it is frequently distinguished by having a colour similar to the rest of the ventrals and not white or cream like the throat.

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* Communicated by Dr. F. E. Beddard, M.A., F.R.S., F.Z.S.

† To avoid frequent repetition the term gastrostege will be abbreviated to "g."

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Xenopeltis unicolor Reinwardt.

Specimen.—California Acad. Sci. No. 16750. Singapore. Adult female: total length 480, tail 58 mm.

The *vertebral artery* arises from the right aortic arch at the 45th g. and courses superficially to the 12th g. It gives off an intercostal branch to each vertebra, and these enter in the median line. The *right aorta* is nearly the same diameter as the left. It gives off eight intercostal branches; each arises as a single trunk which bifurcates midway to the parieties, and the forks enter on either side of the median line. The *dorsal aorta* begins at the 52nd g. The *intercostal* branches arise anteriorly as a single trunk which upon reaching the parieties bifurcates, one fork entering on each side. Before the gall-bladder these bifurcate nearer to their origin, and behind this organ they are symmetrically paired. The right kidney receives two *renal arteries*; the first enters the second lobe, and the second the sixth lobe. The left kidney receives one artery which enters at the second lobe.

Polyodontophis geminatus Boie.

Specimen. — California Acad. Sci. No. 16751. Botanical Gardens, Singapore. Adult male.

The *trachea* enters the lung at the level of the 36th g.; it terminates two gastrosteges further on, and is without an intrapulmonary prolongation. The *tracheal membrane* is bare to a trifle above the base of the heart, at which point it acquires a thin lining of shallow-celled respiratory tissue. The *right lung* is lined with air-cells to the level of the 55th g. There is a *free apex* reaching forward for the distance of two gastrosteges and in relation with the right side of the trachea. The *left lung* is entirely suppressed. The *heart apex* is at the 38th, and the tip of the *liver* at the 50th g.

There are 144 *gastrosteges*. The *scales* are in 17 rows anteriorly and the same posteriorly.

POLYODONTOPHIS COLLARIS Gray.

Specimen.—California Acad. Sci. No. 26783. Mo Kan Shan, Chekiang Prov., China. Adult male.

The *tracheal membrane* begins to be lined with respiratory tissue a little before the base of the heart. The *trachea* enters the lung at the level of the 38th g. The *right lung* is lined with respiratory tissue to the 60th g. There is a *free apex* 3 mm. long in relation with the right side of the trachea. The *left lung* is entirely suppressed. The *heart apex* is at the level of the 36th and the tip of the *liver* at the 54th g. This is an unusually long distance between these organs, as the average of a Colubrine serpent is about ten gastrosteges. The points of all the *teeth* on the maxillary, palatine, and pterygoid bones are brown. The *mandibular teeth* are not in the normal alignment; those in the anterior third of the series are abruptly faulted inwards, so that they are set in about ·7 mm. from the line of the remaining teeth.

There are 172 *gastrosteges*. The *scales* are in 17 rows anteriorly and the same posteriorly.

THAMNOPHIS ORDINOIDES Baird & Girard*.

The *salient character* is the range of variations that occurs in the number of scale-rows. A series of over one hundred specimens has been studied, and the following eight formulæ recorded:—21–19–17, that is 21 rows forward, decreasing to 19, and further along to 17; 19–21–19–17, that is 19 rows forward, increasing to 21 at about the level of the heart and continuing to the end of the liver, then decreasing to 19, and further on to 17; 19–17; 19–17–15; 19–17–15–13 (13 is the lowest number of scale-rows on the body that has been recorded in *Thamnophis*); 17–19–17–15; 17–15; 15–17–15; these lower counts prevail in specimens from the State of Oregon.

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* According to the classification of the North American Garter-snakes as set forth by A. G. Ruthven, Esq., in his memoir, "Variations and Genetic Relationships of the Garter-snakes," 1908, Bulletin 61, U.S. National Museum, this species includes *Tropidonotus leptocephalus* (B. & G.) and *T. vagrans* (B. & G.).

Specimen. — U.S. National Museum No. 504006. Sausalito Peninsula, California. Adult female.

The *tracheal membrane* begins at the glottis; anteriorly it lies along the dorsal and right quadrant of the tube, and further on, at about the 16th gastrostege, it gradually winds to the dorsal quadrant. Anteriorly it is narrow and the ends of the cartilaginous rings are in apposition; at the 6th g. it is 1 mm. wide and begins to be lined with alveolar tissue; where the trachea enters the lung the membrane is 3·5 mm. wide and its alveolar lining becomes confluent with the respiratory tissue of the lung. The air-cells on the membrane near the end are smaller than those lining the anterior portion of the lung. The *trachea* enters the lung at the 24th g. From without it appears to terminate in an obtuse angle a few millimetres posterior to the base of the rudimentary lung; from within it is seen to continue along the ventral surface of the lung as a narrow, straight, and shallow gutter of fibrous tissue which reaches nearly to the anangious portion. The *right lung* is lined with pulmonary tissue to about the 40th g.; from this point on the air-cells become larger, more irregular, and deeper; they may be said to terminate, and the anangious portion to begin, at about the 45th g. From this point the lung continues as an air-sac to the level of the 106th g.

There is a *free apex* extending forward 8 mm. in relation with the right side of the trachea; this apex opens into the lung by a restricted aperture, 2·5 mm. in diameter, which is just anterior to the opening in the rudimentary lung. The rudimentary *left lung* is 7 mm. long, lined with air-cells, and opens into the trachea at a point 4·5 mm. anterior to where the trachea terminates in the right lung.

The *vertebral artery* rises from the right aortic arch at the level of the 20th gastrostege and is superficial in its course to the 10th g. It gives off five intercostal branches: I.–20; II.–16; III.–15; IV.–14; V.–12; and one branch to the œsophagus at the 14th g. The *right aorta* gives off a single intercostal branch close to its junction with the left; this branch arises at the 29th g., courses upwards and forwards and enters at the 27th g. The *left aorta* is only a trifle larger than the right and is without branches. The *dorsal aorta* begins at the 29th g.

There are sixty *intercostals*, and all but Nos. LVIII. and LIX. enter in the mid-dorsal line. The gastrostege level at which they leave the aorta is as follows:—I.–31; II.–35; III.–41; IV.–44; V.–50; VI.–53; VII.–55; VIII.–57; IX.–60; X.–62; XI.–64: XII.–66; XIII.–68; XIV.–72; XV.–73; XVI.–75; XVII.–77; XVIII.–79; XIX.–82; XX.–84; XXI.–86; XXII.–88; XXIII.–90; XXIV.–92; XXV.–93; XXVI.–95; XXVII.–96; XXVIII.–99; XXIX.–101; XXX.–103; XXXI.–104; XXXII.–106; XXXIII.–108; XXXIV.–110; XXXV.–111; XXXVI.–112; XXXVII.–113; XXXVIII.–115; XXXIX.–116; XL.–117; XLI.–119; XLII.–121; XLIII.–122; XLIV.–

123; XLV.–126; XLVI.–128; XLVII.–129; XLVIII.–131; XLIX.–132; L.–136; LI.–137; LII.–138; LIII.–142; LIV.–143; LV.–145; LVI.–147; LVII.–149; LVIII.–152; LIX.–153; LX.–156.

The courses of the intercostals vary slightly in different parts of the body. All but the last, LX.–156, enter the parieties anterior to their points of origin. Anteriorly the difference is only a millimetre or so; at the posterior end of the liver it has increased to an average of three to four millimetres, equivalent to the length of one vertebra. In the region of the kidneys each artery runs forward the distance of about two vertebræ before entering the body-wall. These latter branches are crossed by the renal arteries; the blood in the intercostal arteries flowing forward and in the renal arteries flowing backward. This arrangement is what might be expected to result from a lengthening of the body in this region. As the kidneys move to the rear the arteries entering them would be drawn out to the rear. As the dorsal aorta is drawn to the rear there is a tendency for the intercostal branches to maintain their former points of entrance; to accomplish this necessitates that they course forward. A few are peculiar in the following details:—I.–31 is the longest, measuring 11 mm.; II.–35 bifurcates, sending branches to the lung and œsophagus; III.–41, XX.–86, and XXI.–95 bifurcate and send one fork to the lung; LVIII.–152 enters 2·7 mm. to the left of the median line, and forks just before reaching the parieties; LIX.–153 enters a similar distance to the right; LX.–156 is the only one that enters the parieties at the same level as its origin, all the others trending forward to a greater or lesser extent.

The *gastric artery* is at the level of the 81st g.; upon reaching the stomach it bifurcates into anterior and posterior branches, the latter a trifle larger. There are three *mesenteric arteries*: I.–119; II.–99; III.–108. There are ten *intestinal*, *rectal*, and *cloacal* arteries; I.–113 is 32 mm. long; II.–119; III.–129; IV.–132; V.–139; VI.–145; VII.–151; VIII.–152; IX.–153; X.–155; the majority of these are long straight vessels.

There are four *renal arteries* on the right and seven on the left side. The right kidney extends from the 116th to the 139th g., and its four arteries leave the aorta as follows:—I.–118; II.–126; III.–129; IV.–135. All of these enter the organ posterior to their origin. No. I. is the largest; at the kidney it divides into an anterior branch which forks to supply the kidney and the ovary, and a posterior branch to the kidney alone. The left kidney extends from the 125th to the 145th g., and is practically the same size as its mate. The seven arteries leave the aorta as follows:—I.–122; II.–127; III.–131; IV.–135; V.–139; VI.–141; VII.–143. No. I. is the largest and forks to supply the ovary. Nos. I. to VI. are quite oblique; Nos. V. to VII. enter the kidney almost directly.

The *external landmarks* of the principal viscera in terms of gastrosteges are as follows:—

Gastrosteges	157	100	per cent.
Heart apex	26	16·8	
Liver, tip	35	22·3	
,, end	70	44·6	
Gall-bladder	86	54·8	
Kidney, right, tip	116	73·8	
,, ,, end	139	88·6	
,, left, tip	125	79·6	
,, ,, end	145	92·3	

The number of *scale-rows* on the body, the sequence in which they are added and suppressed, and the gastrostege level at which these changes occur may be thus presented:—

Neck.

21 rows, IV row ends, right 8th, left 7th gastrostege, leaving:

Body.

19 rows,	V row	added,	right 26th,	left 24th	gastrostege,	making:
21 ,,	V ,,	ends,	,, 72nd,	,, 72nd	,,	leaving:
19 ,,	IV ,,	,,	,, 87th,	,, 90th	,,	,,
17 ,,	which are continued to the vent.					

An inspection of this table will show that on the body the scale-row count is raised from 19–21 rows at about the level of the base of the heart, and that this maximum number of rows continues to the posterior end of the liver, where the original count of 19 rows is resumed. A further tapering of the body is indicated by the reduction of the 19 rows to 17, and this occurs just posterior to the gall-bladder. The relation existing between the position of the viscera and the added and suppressed scale-rows has been studied in fifty specimens of this species. The example just recorded offers the normal condition for individuals inhabiting the Sausalito Peninsula.

TROPIDONOTUS VIBAKARI Boie.

The *salient character* of this species is the peculiar type of intromittent organ. This has warranted the removal of the species from *Tropidonotus* and the establishment of a new genus *Hebius* *.

Specimen.—California Acad. Sci. No. 15861. Yokohama, Japan. Adult female: total length 644, tail 140 mm.

The *trachea* ceases abruptly at a point just posterior to the apex of the heart. The *tracheal membrane* begins at the glottis and extends along the right side of the tube; from the origin to the 15th g. it is finely plicate; it then becomes lined with respiratory tissue, the alveoli being at first very shallow and indistinct; at the level of the auriculo-ventricular septum the shallow cells change rather suddenly to the type of those in the lung. The *trachea* ceases abruptly at a point just posterior to the heart apex. The *right lung* is lined with pulmonary tissue to about the 44th g. There is a *free apex* 1·5 mm. in length. There is a rudimentary *left lung*, a mere sac without air-cells or an opening into the trachea.

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* Thompson, P. Z. S. 1913, p. 424.

The *external landmarks* of the principal viscera in terms of gastrosteges are as follows:—

Gastrosteges	147	100 per cent.
Heart apex	29	19·5
Liver, tip	36	25·7
,, end	64	50·7
Gall-bladder	76	55·7
Kidney, right, tip	119	76·5
,, ., end	128	87
,, left, tip	126	82·7
,, ,, end	137	93
Ileo-cæcal valve	128	85·5

There are 19 *scale-rows* anteriorly; at the level of the gall-bladder the IV row is dropped, leaving 17 rows which are continued to the vent.

TROPIDONOTUS SAUTERI Boulenger.

Specimen.—California Acad. Sci. No. 18988. Kanshirei, South Formosa. Adult female.

The *tracheal membrane* begins to be lined with respiratory tissue a little anterior to the base of the heart. The *trachea* enters the lung at the level of the 24th gastrostege. The *right lung* is lined with respiratory tissue to the 55th g. There is a *free apex* about one and one-half gastrosteges long, in relation with the right side of the trachea. The rudimentary *left lung* is at the 25th g.: it is a mere fibrous sac, 2 mm. long, without pulmonary tissue. The *heart apex* is at the 24th, and the tip of the *liver* at the 32nd g.

There are 17 rows of *scales* anteriorly and the same posteriorly. *Gastrosteges* 128.

PSEUDOXENODON SINENSIS Boulenger.

Specimen.—Brit. Mus. Nat. Hist. Ex. No. '13–18. Yunnan Fu, China. Adult male.

The tissues in this specimen are in too fragile a state to permit of a satisfactory autopsy. The *tracheal membrane* is developed as a broad thin sheet; the air-cells begin at the 28th g. The cartilaginous rings are broader and thinner than in most species. There is a cervical set of *air-chambers* above and to the right of the trachea; these are divided into about seven compartments by transverse partitions. Each compartment opens into the trachea by a large round foramen situated on the tracheal membrane; these are opposite the following gastrosteges: 3, 7, 11, 15, 19, 23, 25. The *right lung* has a large free apex. There is no trace of the *left lung*.

The *external landmarks* of the principal viscera in terms of gastrosteges are as follows:—

Gastrosteges	140	100 per cent.
Heart apex	30	21·4
Liver, tip	40	28·6
,, end	66	42·8
Gall-bladder	75	53·6
Kidney, right, tip	98	67·2
,, ,, end	120	85·7
,, left, tip	111	79·2
,, ,, end	128	91·3

The number of *scale-rows*, the sequence in which they are suppressed, and the gastrostege level at which they terminate are as follows:—

19 rows, IV row ends, right 68th, left 71st gastrostege, leaving:
17 ,, V ,, ,, ,, 81st, ,, 81st ,, ,,
15 ,, which are continued to the vent.

ZAMENIS CONSTRICTOR Linnæus.

Specimen.—U.S. National Museum No. 504301. Sausalito Peninsula, California. Adult female.

The *tracheal membrane* begins at the glottis and extends along the left quadrant of the tube. It is bare anteriorly but becomes lined with respiratory tissue at the 15th g.; at first the air-cells are large and shallow, further on assuming the type of those in the lung. The *trachea* enters the lung at the 34th g.; a few millimetres posterior to the rudimentary lung it tapers to a narrow fibrous intrapulmonary band, less than 1 mm. wide, which continues along the ventral wall of the lung to the anangious part. The intercartilaginous fibrous portion of the trachea is pigmented a dark grey, which is in sharp contrast to the white of the cartilages and gives the trachea a regularly banded appearance. There is a *free apex* 5 mm. long, closely bound to the right side of the trachea, and with two small openings into the lung. The *right lung* is lined with alveoli to the 54th g., where they cease rather abruptly and the lung becomes anangious. The *left lung*, 2·5 mm. long, is at the 36th g.; it is lined with air-cells and opens into the trachea.

The *vertebral artery* courses superficially over seven gastrosteges; it arises from the right aortic arch at the 30th g. and enters in the median line at the 23rd g. It gives off two intercostal branches: I.–28, II.–26, and two minute twigs to the œsophagus: I.–27, II.–25. In another specimen (No. 504043, same locality and sex) having the same number of gastrosteges and with the heart at the same level, this artery courses over nine gastrosteges and gives off six intercostal branches: I.–28;

II.–27; III.–26; IV.–24; V.–22; VI.–21, and one to the œsophagus: I.–23.

The *external landmarks* of the principal viscera in terms of gastrosteges are as follows:—

Gastrosteges	168	100 per cent.
Heart apex	35	20·9
Liver, tip	47	28
,, end	77	45·8
Gall-bladder	99	59
Kidney, right, tip	135	80·4
,, ,, end	155	92·2
,, left, tip	142	84·5
,, ,, end	160	95·2

The parietal *pleura* is pigmented along an irregular line on the flanks. The parietal *peritoneum* is darker and the pigment is more diffused until at the level of the pancreas it is quite black. The visceral peritoneum covering the liver is slightly darkened.

The number of *scale-rows* on the body, the sequence in which they become suppressed, and the gastrostege level at which they terminate may be presented thus:—

Neck.
19 rows, IV row ends, right 5th, left 136th gastrostege, leaving:
Body.
17 rows, IV row ends, right 94th, left 95th gastrostege, leaving:
15 ,, which are continued to the vent.

ZAMENIS RHODORHACIS Jan.

The *salient characters* are:—The sequence of suppression of the scale-rows which is first No. IV, then IX, and finally VII;—over one hundred species of Colubrine snakes have been examined for this character, and this is the only one recorded with this formula. The caudad position of the heart. The attenuated liver. The of distance the gall-bladder from the liver,—fifteen gastrosteges, while it is usually ten in a Colubrine.

Specimen.—Brit. Mus. Nat. Hist. Ex. No. '13–7 *a*. Aden, Arabia. Adult male.

The *tracheal membrane* lies along the right side of the tube from the glottis to a little before the base of the heart where it becomes dorsal; it is narrow throughout and lies in a lax state, the interrupted ends of the cartilaginous semirings being in apposition; it is not attached to the extremities of the cartilages, but along a line about ·5 mm. distant. The air-cells begin at about the 55th g. The *trachea* ends abruptly at the 62nd g., there being no trace of an intrapulmonary bronchus. The *left lung* is completely suppressed. The *right lung* loses the lining of air-cells at the 77th g. There is an *apex* 3 mm. long, attached to the left side of the trachea and communicating with the lung by a restricted opening.

The *heart* is situated 27·6 per cent. down the vertebral column; this is a little further to the rear than is usual in a Colubrine snake. The *liver* is much attenuated both anteriorly and posteriorly. The parietal *pleura* is very dark, the parietal *peritoneum* is almost black, and the visceral coverings are unpigmented.

The *vertebral artery* rises from the right aortic arch at the 54th g., courses superficially to the 44th g., and enters in the median line. There are four intercostal branches: I.–53; II.–52; III.–50; IV.–47. The *right aorta* has one large intercostal branch, I.–60, which enters to the left of the median line. The *dorsal aorta* begins at the 62nd g. The *intercostal* arteries enter the left side at the following gastrostege levels: I.–70; II.–72; III.–75; IV.–77; V.–81; VI.–84; VII.–85; VIII.–87; IX.–89; X.–92; XI.–95; the branches beyond are injured.

The *external landmarks* of the principal viscera in terms of gastrosteges are as follows:—

Gastrosteges	221	100 per cent.
Heart apex	61	27·6
Liver, tip	66	29·8
,, end	109	49·5
Gall-bladder	134	60·4
Testis, right, tip	160	72·3
,, ,, end	167	75·8
,, left, tip	172	77·8
,, ,, end	179	81·0
Kidney, right, tip	184	84·2
,, remainder injured.		

The number of *scale-rows*, the sequence in which they are suppressed, and the gastrostege level at which they terminate is as follows:—

Neck.
21 rows, IV row ends, right 7th, left 6th gastrostege, leaving:
Body.
19 rows, IV row ends, right 129th, left 128th gastrostege, leaving:
17 ,, IX ,, ,, ,, 129th, ,, 129th ,, ,,
15 ,, VIII ,, ,, ,, 151st, ,, 151st ,, ,,
13 ,, which are continued to the vent.

The bodies of most serpents taper posteriorly and this is usually associated with the loss of definite scale-rows. The rows that are suppressed are prone to be either on the middle of the flanks or one or two rows distant from the median. When the rows on the flanks are dropped the levels at which they terminate are usually bilaterally asymmetrical, there being a difference of from one to four gastrosteges. When the rows adjoining the median are suppressed, the rule is for them to terminate at the same level. The pioneer work in this field has been done by A. G. Ruthven, Esq. Since the days of Cope, no American worker has given so astute a suggestion to students of herpetology as is contained in his memoir on the genus *Thamnophis*.

ZAMENIS FLORULENTUS Geoff.

Specimen.—Brit. Mus. Nat. Hist. Ex. No. '13–5. Blue Nile, Soudan. Adult male.

The *tracheal membrane* lies on the left side of the tube, and is narrow, being 1·5 mm. wide at the base of the heart. The air-cells begin at the 40th g. The *trachea* terminates at the 50th g. The remnant of the bronchus continues as a fine intrapulmonary streak of fibrous tissue as far as the anangious region. The *right lung* is without a free apex; the air-cells extend to the 66th g. A vestige of the *left lung* is present at the 50th g.; it is without air-cells or an opening into the trachea.

The *vertebral artery* leaves the right arch of the aorta at the 43rd g. and enters the parieties at the 35th. It has four intercostal branches which enter in the median line: I.–43; II.–41; III.–39; IV.–37. The *right aorta* extends from the 43rd to the 51st g. It has two intercostal branches: I.–45; II.–49.

The *external landmarks* of the principal viscera in terms of gastrosteges are as follows:—

Gastrosteges	197	100 per cent.
Heart, apex	48	24·4
Liver, tip	56	28·5
,, end	96	48·7
Gall-bladder	124	62·9
Testis, right, tip	144	73
,, ,, end	148	75·2
,, left, tip	158	80·2
,, ,, end	162	82·3
Kidney, right, tip	166	84·2
,, ,, end	179	90·9
,, left, tip	177	90
,, ,, end	189	96

The number of *scale-rows*, the sequence in which they are suppressed, and the gastrostege level at which they terminate, are as follows:—

Neck.
23 rows, IV row ends, right 11th, left 10th gastrostege, leaving:
Body.
21 rows, IV row ends, right 120th, left 120th gastrostege, leaving:
19 ,, VIII ,, ,, ,, 122nd, ,, 122nd ,, ,,
17 ,, X ,, ,, ,, 153rd, ,, 153rd ,, ,,
15 ,, which are continued to the vent.

COLUBER OXYCEPHALUS Boie.

The *salient characters* of this serpent are as follows:—The system of air-chambers opening into the trachea. The length of the right lung and the considerable development of the left; both lungs are larger than in any Colubrine as yet recorded. The intercostal branches of the vertebral artery do not all enter in the median line. The highly differentiated intromittent organ. Finally the ugly and fierce disposition.

Specimen.—Brit. Mus. Nat. Hist. Ex. No. '13–17 *a.* Balakappan, Dutch Borneo. Adult male.

The *trachea* terminates abruptly at the 65th g. There is no trace of an intrapulmonary bronchus, the last vestige, the linear arrangement of the air-cells even being absent. The intercartilaginous membrane is black, and in sharp contrast to the white of the cartilages. Each end of a cartilage where the ring is interrupted by the membrane is free to the extent of ·5 mm.; this gives a comb-like appearance to the line of junction of the cartilaginous and membranous portion. The *tracheal membrane* is not extensively developed, being uniformly about 2 to 3 mm., and at the base of the heart 4 mm. wide. Anteriorly it lies along the right and posteriorly along the dorsal side of the trachea. It is bare to the 49th g., where it acquires a lining of air-cells that posteriorly become continuous with those of the lung.

The body-cavity beneath the trachea from the level of the paired gular shields to the base of the heart is converted into an *air-chamber*. This structure gives the impression of crowding and filling all the available space. The walls are of stout connective tissue and are closely bound to the surrounding structures. The air-chamber is divided into fifteen separate compartments by connective tissue bulkheads that are imperforate. The position of the posterior wall of each compartment in terms of gastrosteges is as follows:—I.–3; II.–8; III.–13; IV.–18; V.–23; VI.–26; VII.–31; VIII.–36; IX.–39; X.–42; XI.–44; XII.–49; XIII.–52; XIV.–54; XV.–56. The after compartment is in relation laterally with the vena cava and the carotid artery and posteriorly with the base of the heart; it even sends a prolongation for a few millimetres along the ventral surface of the pericardium. Compartments XII. to XV. cease to be attached to the parieties and lie between the vessels of the neck and the trachea. Each compartment opens into the trachea by an *aperture*; in several cases there are two and even three openings. These apertures are situated on the tracheal membrane, close to the ventral row of cartilage-ends. They are oval, with the long axis in the sagittal plane, from 2 to 3·5 mm. in diameter, and extend over the space of several tracheal cartilages. Where they exist, the cartilages terminate flush with the rim of the opening, and do not have the free extremity that is present elsewhere. The first structure of this nature was discovered by Dr. Beddard * in *Ophiophagus*. In the Hamadryad it is dorsal to the trachea, whereas in *Gonyosoma* it is ventral.

The *right lung* extends posteriorly to the 230th g., which is just four shields anterior to the anal. It is one of the longest recorded in a Colubrine and resembles *Coluber corais* in this respect †.

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* P. Z. S. London, 1903. vol ii. p. 319.

† Beddard, P. Z. S. 1906, p. 520.

There is an *apex* about 18 mm. long, reaching to the 61st g.; it is above and to the right of the trachea, to which it is closely adherent posteriorly, the terminal 6 mm. only being free. The lumen of the apex communicates directly with the lung and is not set off by a restriction. The respiratory tissue ceases rather abruptly at about the 80th g.; its disappearance is not accompanied by the gradual change in size and shape of the air-cells so frequently seen.

The *left lung*, 86 mm. long, extends from the 62nd to the 80th g., and is the largest recorded in a Colubrine snake. The base is attached to the right side of the ventral surface of the right lung; it is 8 mm. long and corresponds to the 64th and 65th g. Though adherent to the right lung there is no direct communication between the two, the interpulmonary septum being imperforate. Just posterior to the base the diameter of the left lung is 7 mm. There is a free apex, 12 mm. long, extending forward nearly to the auriculo-ventricular septum; it is in relation with the left side of the pericardium, to which it is closely adherent. The posterior end of the lung extends 6 mm. beyond the anterior tip of the liver. The left lung is closely adherent to the inferior vena cava, and hides this vessel when the cœlum is opened from beneath. The left bronchus is merely a little bulge on the ventral side of the trachea 4 mm. anterior to its termination. There is no trace of a left intrapulmonary prolongation or fibrous band. The lung is lined throughout with regular air-cells; these are larger and more shallow than in the right lung.

The *pulmonary artery* courses along the right lateral edge of the right lung. Its principal branches are as follows: No. I, a minute one to the ventral surface of the apex. No. II, a large one which is at the level of the middle of the apex and winds around to its outer side and then turns to the dorsal surface of the lung. No. III enters the lung at the base of the apex. No. IV, very small, crosses to the right over the middle of the ventral surface of the isthmus joining the two lungs. No. V, a large branch, which runs along the posterior border of the isthmus and divides, sending several twigs to the right lung and a small branch to the left lung. The branches beyond are too irregular to describe in detail; some enter the lung direct, some wind around the right side to the dorsal surface, and one large one crosses the ventral surface and is distributed to the left side.

The *right aorta* gives the impression of being a branch of the vertebral artery *. It arises from the right side and is less than one half the calibre of that artery. It flows directly to the rear, forming an acute angle with the vertebral. It crosses to the left aorta and upon reaching that vessel at the 64th g. it courses alongside to the 68th g. before joining to form the dorsal aorta. There is a single intercostal branch which enters to the left of the median line at the 61st g.

* Quite as in *Zamenis flagelliformis*, Beddard, P. Z. S. 1904, vol. i. p. 338.

As it was not feasible to study the *vertebral artery* without injuring the air-chambers, this record was taken from another specimen (17 *b*, same locality), an adult female, with 243 gastrosteges and the heart apex at the 63rd g. The artery arises at the level of the 56th g. and courses superficially to the 23rd g., where it enters in the median line. There are fourteen intercostal arteries arising as follows: I.–56, this arises quite in the anterior angle formed by the vertebral and the right aorta and enters in the median line; II.–56, enters to the left; III.–52, bifurcates, and one fork enters on each side of the body; IV.–50, bifurcates, both forks enter in the median line; V.–47, this and the rest of the branches are single and enter in the median line; VI.–43; VII.–42; VIII.–40; IX.–39; X.–37; XI.–35; XII.–33; XIII.–30; XIV.–27.

In almost all serpents the intercostal branches of the vertebral artery enter the body-wall in the mid-dorsal line*. In this species the second and third branches offer two distinct types which are exceptions to this general rule.

The *right aorta*, ·5 mm. in diameter, joins the left, 1·5 mm. in diameter, to form the *dorsal aorta* at the 68th g. The *intercostal* arteries anterior to the kidneys enter the parieties to the right or to the left of the median line: I.–73 and II.–83 to left; III.–87 to right, and at the entrance it sends a branch to the left side which bifurcates, sending one branch into the parieties and the other to the peritoneal muscle. In the lumbar region the intercostal arteries enter as follows:—At the 199th, 203rd, 204th, and 206th g. to the left. At the 208th g. a pair, one from each side of the aorta, and entering on either side of the vertebral column. At the 215th g. a single artery enters to the left. At the 215th and the 218th g. the vessels are paired. At the 226th g. the last artery is single and enters to the left.

The right *spermatic artery* arises at the 167th g. and enters just anterior to the middle of the gonad. The left arises at the 181st g. and enters the middle of the organ. Just posterior to each testis there is an artery arising from the aorta which enters the cord. There are five *renal arteries* on the right side. They arise as follows: I.–203, courses to the rear for about one gastrostege, while the remainder enter nearly directly; II.–205; III.–208; IV.–215; V.–222. The left kidney receives six arteries as follows: I.–207; II.–209; III.–212; IV.–217; V.–219; VI.–222.

The *anterior vena cava* at the 40th g. is looped to form an S-shaped curve, parallel to the median plane, and with the recurrent limb measures 6 mm. This suggests the provision for the lengthening of the vein when the neck is inflated.

In the female (No. 17 *b*) the *gall-bladder* is 14 mm. in diameter, the *pancreas* 18 mm. long, and the distance between the two organs 6·5 mm.

The *hepatic duct* divides into about half a dozen tubes of unequal size. The *cystic duct*, 29 mm. long, arises from the anterior half of the ventral surface of the gall-bladder. Midway between the gall-bladder and the pancreas it divides into two branches. The smaller branch is one-third the diameter of the larger and divides into two branches near the anterior border of the pancreas. On the inferior surface of the pancreas the three branches of the cystic duct join the several branches of the hepatic duct to form a small but complex rete. Similarly complicated anastomoses have been recorded in the Python by Poelman and in the Hamadryad by Beddard.

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* Beddard, P. Z. S. 1904, vol. i. p. 368.

The *external landmarks* of the principal viscera in terms of gastrosteges are as follows:—

	Male.	Female.	Male. per cent.	Female. per cent.
Total number of gastrosteges	234	243	100	100
Heart apex	65	63	28	26
Liver, anterior tip	81	75	35	31
,, posterior end	115	108	45	44
Gall-bladder, centre	139	137	59	56
Pancreas, centre	142	139	61	57
Testis, right, anterior tip	168	...	72	...
,, ,, posterior end	173	...	74	...
,, left, anterior tip	180	...	77	...
,, ,, posterior end	185	...	79	...
Kidney, right, anterior tip	202	208	86	85
,, ,, posterior end	225	233	96	96
,, left, anterior tip	204	211	87	87
,, ,, posterior end	233	233	99	96

It will be noted that in the female there are nine more gastrosteges; in other words, the spinal column contains nine more vertebræ. In each specimen the posterior end of the liver and the anterior tip of the right kidney are very nearly at the same relative level. In each specimen the posterior end of the left kidney is exactly at the 233rd gastrostege. This indicates that the additional vertebræ in the female are situated between the end of the posterior kidney and the vent. The position of the vagina may require that the body be lengthened in this region.

This serpent has received considerable attention from the early savants. It was discovered by Reinwardt in Java. By Wagler it was removed from the genus *Coluber* and made the type of the genus *Gonyosoma*; the determining character for this change was the lateral angles on the ventral shields; these are well shown in the plates given by Schlegel and Jan. Günther, in the 'Reptiles of British India,' writes: "It is described as exceedingly strong and fierce, defending itself ferociously when attacked. It raises nearly the anterior third vertically from the ground before it strikes." Cope, in the 'Crocodilians, Lizards, and Snakes of North America,' gives a figure of the hemipenis and places the genus apart from all the Colubrinæ, owing to the fact that the intromittent organ is highly differentiated. To this may now be added the character to be found in the system of air-chambers opening into the trachea. These structural conditions will justify the removing of this serpent from the genus *Coluber* and reinstating the genus *Gonyosoma* of Wagler.

PHILOTHAMNUS SEMIVARIEGATUS Smith.

Specimen.—Brit. Mus. Nat. Hist. Ex. No. '13–6. Blue Nile, Soudan. Adult female.

The *trachea* is black and terminates at the 51st g. The *membrane* is well developed and lies along the right side of the tube: the air-cells begin at the 45th g. The *right bronchus* persists as an intrapulmonary streak to the 57th g. The *right lung* is lined with air-cells to the 68th g., where they end very abruptly. The *left lung* is a small air-sac opening into the trachea at the 51st g.

The *external landmarks* of the principal viscera in terms of gastrosteges are as follows:—

Gastrosteges	204	100	per cent.
Heart apex	51	25	
Liver, tip	65	31·8	
,, end	98	48	
Gall-bladder	114	55·8	
Kidney, right, tip	184	90	
,, ,, end	198	97	
,, left, tip	187	91·5	
,, ,, end	200	98	

The *scale-rows*, the sequence in which they are suppressed, and the gastrostege level at which they terminate are as follows:—

Neck.
17 rows, IV row ends, right 4th, left 4th gastrostege, leaving:
Body.
15 rows, VI row ends, right 112th, left 110th gastrostege, leaving:
13 ,, IV ,, ,, ,, 114th, ,, 113th ,, ,,
11 ,, which are continued to the vent.

CERBERUS RHYNCHOPS Schneider.

The *salient characters* of this species are: All the teeth, without exception, are grooved. The tracheal membrane is lined with a peculiar type of deep air-cells. The shifting of the heart to the rear. The reduction of the renal arteries to one on one side and two on the other. The particularly tough connective tissue, which in this respect resembles that found in an Hydrophid and differs from the texture in a Colubrine.

Specimen.—California Acad. Sci. No. 15301. Cavite Viejo, Luzon, Philippine Islands. Cranium.

There are 16 *maxillary teeth* which are grooved on the external quadrant; separated from these by a small space are two slightly enlarged teeth, in a special compartment of mucous membrane, and grooved on the anterior quadrant. There are 9 large *palatine teeth* which are grooved on the external quadrant. There are 21 *pterygoid teeth*, about one half the size of the palatine teeth and grooved on the internal quadrant. There are 23 *mandibular teeth* which are grooved on the external quadrant.

Specimen.—California Acad. Sci. No. 15309. Caloocan, Luzon, Philippine Islands. Adult male.

The *tracheal membrane* begins at the glottis and lies along the right side of the tube; at the 9th g. it is 1 mm. wide and at the 17th g. it is 2 mm. wide and begins to be lined with air-cells; at the 44th g. it has increased until it forms three-fourths of the circumference of the trachea; towards the base of the heart it decreases somewhat in size and merges with the lung. The *respiratory tissue* lining the tracheal membrane is of a specialized type, the individual air-cells being from three to four times deeper than wide. When the cartilaginous portion is laid open the lumen appears to be but 2 mm. in diameter; to the left may be seen the openings of the air-cells, which are in longitudinal rows. The cartilages lie at first on the right and beyond the 4th g. on the ventral side of the tube. The *trachea* ends abruptly at the 54th g., and there is not a trace of an intrapulmonary bronchus. The *right lung* terminates at the 94th g., which is the same level as the end of the liver. The posterior extremity is free and rounded as in the Boine type, and not bound to the parieties; upon opening the cœlum it may be seen just posterior to the end of the right lobe and to the right side of the left lobe of the liver. The lung is lined with air-cells throughout, but towards the end they become shallow and irregular. There is a free apex, 2 mm. long, on the right of the trachea, and extending to the 52nd g. The *left lung* is completely suppressed.

The *heart* is located rather to the rear, being in terms of gastrosteges 33 per cent. down the vertebral column, in Colubrine snakes the prevailing position is about 25 per cent. The *liver* is divided by an incisure along the ventral surface into right and left lobes; the right lobe begins at the 68th and ends at the 92nd g.

The *pulmonary artery* divides into two equal branches opposite the 51st g. The anterior is distributed to the trachea, the posterior to the lung. The branch to the lung divides just before the tip of the apex of the lung into dorsal and ventral branches.

The *vertebral artery* arises from the right aortic arch at the 48th g. and runs superficially to the 14th g.; just before disappearing it sends a minute twig forward to the next intervertebral space. It gives off 23 intercostal branches which enter in the median line; the gastrostege level at which they enter the parieties is as follows:—I. arises just at the origin of the vertebral and courses alongside of it to the level of the 45th g.; II.–43; III.–44; IV.–42; V.–41; VI.–39; VII.–38; VIII.–37; IX.–35; X.–34; XI.–33; XII.–30; XIII.–28; XIV.–27; XV.–26; XVI.–25; XVII.–24; XVIII.–22; XIX.–21;

XX.-20; XXI.-18; XXII.-16; XXIII.-14. The *right aorta* gives off two intercostal branches which enter in the median line: I.-47; II.-54. The *dorsal aorta* begins at the 58th g. and as nearly as can be determined gives off 44 *intercostal* branches which enter in the median line; the first is at the 57th g. and the last at the 148th g.

There are four *gastric arteries*, the largest being at the 87th and the 91st g. The *superior mesenteric artery* is at the 102nd and the *inferior mesenteric artery* is at the 112th g. Each testis receives a single *spermatic artery*; the right artery leaves the aorta at the 112th g. and enters the organ just below the middle; the left arises at the 119th g. and enters near the posterior end of the gonad. The right *renal artery* is single; it leaves the aorta at the 121st g. and enters near the anterior tip of the organ. The left kidney has two arteries: I. leaving the aorta at the 128th g. and entering near the tip; II. at the 137th g. and entering near the end of the organ.

The *external landmarks* of the principal viscera in terms of gastrosteges are as follows:—

Gastrosteges	151	100 per cent.
Heart apex	53	35·1
Liver, tip	62	42
,, end	94	62·2
Gall-bladder	102	67·5
Testis, right, tip	111	73·7
,, ,, end	118	78·2
,, left, tip	116	76·8
,, ,, end	123	81·5
Kidney, right, tip	122	80·8
,, ,, end	135	89·4
,, left, tip	129	86·5
,, ,, end	141	93·5

The number of *scale-rows*, the sequence in which they become suppressed, and the gastrostege at which this change occurs may be thus presented:—

Neck. There are from 28 to 25 rows, which to the level of the 15th g. are asymmetrical and too irregular to record.

Body.

23 rows, VI row ends, right 84th, left 98th gastrostege, leaving:
21 ,, IV ,, ,, 106th, ,, 105th ,, ,,
19 ,, III ,, ,, 132nd, ,, 131st ,, ,,
17 ,, which are continued to the vent.

If this scale formula be compared with the one given under *Thamnophis ordinoides*, it will be seen that two fundamentally different types exist.

In the Colubrine snake the rows that were added or suppressed were in *adjoining series*.

In the Opisthoglyphine serpent they were *not in adjoining* *series*, *i. e.* one, No. IX, was next to the median row, and the other, No. IV, was on the flank.

The scale formula of over one hundred species has been studied and the serpents possessing the non-adjoining type have usually been in the Dipsadomorphinæ. The following were the exceptions:—*Boodon lineatus* Dum. & Bibr., *Zamenis rhodorhacis*, Jan, *Z. florulentus* Geoff., and *Coluber oxycephalus* Boie.

This species is common in the vicinity of Manila, where it inhabits the brackish water swamps that border the Bay. Over a score have been seen in shallow places resting or moving slowly on the bottom. They are able to remain beneath the surface for several hours at a stretch. This may explain the need of the extensive respiratory area in the trachea and lung.

Leptodira hotambœia Laurenti.

Specimen.—Brit. Mus. Nat. Hist. Ex. No. '13–10. Fort Hall, British East Africa. Adult male: total length 950, tail 85 mm.

The *trachea* terminates at the 34th gastrostege; it ends abruptly, and the only trace of an intrapulmonary continuation is in a regular arrangement of the air-cells in an imaginary line in its prolongation. The *tracheal membrane* begins near the glottis on the left side; further on it winds to the dorsal side of the tube, and at the level of the 28th g. it becomes lined with shallow air-cells. The *right lung* is reticulate to the 47th g. The *left lung*, 2·3 mm. long, is at the level of the apex of the heart; it is closely adherent to the left side of the pericardium, and opens into the trachea at the 33rd g.

The *vertebral artery* arises from the right arch at the 29th gastrostege, and is superficial to the 18th; it gives off five branches, all of which enter in the median line. The gastrostege level of these branches is as follows:—I.–27; II.–26; III.–23; IV.–22; V.–20.

The *right aortic arch* joins the left at the 38th gastrostege; at the 31st it gives off a single intercostal branch, which bifurcates close to the entrance in the median line, one fork supplying each side. The *intercostals* from the anterior part of the dorsal aorta enter in the median line.

The *external landmarks* of the principal viscera in terms of gastrosteges are as follows:—

Gastrosteges	163	100 per cent.
Heart apex	34	20·9
Liver, tip	41	25·2
,, end	81	49·7
Gall-bladder	90	55·3
Kidney, right, tip	129	80
,, ,, end	155	95
,, left, tip	136	83·5
,, ,, end	156	95·7

The number of *scale-rows* on the body, the sequence in which they are increased or suppressed, and the gastrostege level at which these changes occur may be thus presented :—

17 rows, IX row added, right 15th, left 17th gastrostege, making :
19 ,, IX ,, ends, ,, 102nd, ,, 104th ,, leaving :
17 ,, IV ,, ,, ,, 105th, ,, 104th ,, ,,
15 ,, which are continued to the vent.

PSAMMOPHIS SIBILANS Linnæus.

Specimen.—Brit. Mus. Nat. Hist. Ex. No. '13–1. Nile Delta, Egypt. Adult male : total length 969, tail 315 mm.

The *tracheal membrane* is narrow, being only 1·5 mm. wide at the base of the heart; it is confined to the left side of the tube and the air-cells commence at the level of the auricles of the heart. The *bronchus* is continued as a fine intrapulmonary fibrous band to the level of the 55th g. The *right lung* is lined with pulmonary tissue to the 58th g. and is without a free apex. The *left lung*, 3 mm. long, opens into the trachea one gastrostege below the apex of the heart.

The *vertebral artery* arises from the right aortic arch at the 36th g.; it gives off six intercostal branches which enter in the median line :—I.–33; II.–32; III.–29; IV.–28; V.–25; VI.–23; a branch to the œsophagus at 20 g.; at the 18th g. it bifurcates, sending a small intercostal branch into the parieties, and a larger one onto the dorsal surface of the œsophagus. The *right aorta* gives off an intercostal at the 36th g. The *common aorta* begins at the 43rd g.; the first few *intercostal* branches enter on the left side.

The *external landmarks* of the principal viscera in terms of gastrosteges are as follows :—

Gastrosteges	166	100 per cent.
Heart apex.........................	41	24·7
Liver, tip	48	28·9
,, end	82	49·4
Gall-bladder	100	60·3
Kidney, right, tip	142	85·7
,, ,, end	163	98
,, left, tip..................	146	88
,, ,, end	164	98·8

There are 19 *scale-rows* on the neck. On the body there are 17 anteriorly, decreasing to 15 and finally to 13 rows posteriorly.

OPHIOPHAGUS BUNGARUS Schlegel.

The *salient characters* of the Hamadryad may be thus enumerated :—The large postparietal plates. The enlarged scales in the vertebral row. (This was first noted in a stuffed specimen in the Leyden Museum in which the skin had been stretched, until, each scale being free, the exact size and form was readily seen.) The extreme degree to which the grooving is developed on the teeth; every tooth except the fangs has one, and some have two and even three distinct grooves. The series of air-chambers in the neck that open into the trachea. The size it attains and its aggressive disposition.

Specimen.—California Acad. Sci. No. 16777. Singapore. Cranium.

The *maxillary bone* extends beyond the palatine a distance of ·8 mm. There are two fangs: the inner, 10 mm. long, are cemented in the erect position; the outer, of the same length, are loose and horizontal. There are three small teeth, 2·5 mm. long, situated on the posterior two-fifths of the bone; each has a groove along the antero-external quadrant that extends the entire length and is deeper and wider towards the base. The *ectopterygoid bone* is widened anteriorly and has a concave border forming an antero-external and an antero-internal process. The *palatine bone* has two processes. The maxillary process is short and directed inwards; its base extends from the middle of the third to the middle of the fifth socket. The vomerine process is narrow and is arched upwards, inwards, and towards the end slightly downwards; its base extends from the socket of the fifth to the sixth tooth. There are eight stout teeth, 2·8 mm. long, and each has three distinct grooves. The deepest groove is on the antero-internal quadrant and extends from the base to the tip. The next is not quite so deep; it is on the inner quadrant and extends from the base nearly to the tip. The last and least pronounced is on the external quadrant; it is deeper on the distal half of the tooth. The *pterygoid bone* is broadly expanded posteriorly and but slightly curved. The articulation with the ectopterygoid extends from the space between the fourth and fifth tooth to a point 2 mm. behind the last tooth. There are ten stout teeth, 1·5 mm. long, situated on the anterior two-fifths of the bone. Each tooth has two grooves; the deeper is on the internal quadrant and the other on the external quadrant. The *dentary bone* bears fourteen teeth, the anterior of which are a trifle the larger. All are deeply grooved along the exterior quadrant.

With the modification of the anterior maxillary teeth as fangs, and the small teeth on the maxillary and dentary bones being grooved, the King Cobra exhibits a further development of the poison apparatus, as the teeth on the palatine and even on the pterygoid bones are also grooved.

Measurements in millimetres.

Base, tip of præmaxillæ to rim of foramen magnum	46
Maxillary	13·9
Ectopterygoid	17·6
Palatine	17
Pterygoid	32·5
Mandible	61·2
Dentary	25·2
Quadrate	20·3
Squamosal	18·7
Fang	10

Specimen.—California Acad. Sci. No. 15340. Butuan, Mindanao, Philippine Islands. Head and neck of an adult.

A native was bitten by this beast at noon and died at seven in the evening. In conformity with the local folk-lore the serpent was decapitated, and the brain scooped out and applied to the wound as an antidote.

The anatomy of this form has been made the subject of a most interesting paper by Dr. F. E. Beddard *, who discovered the existence of the remarkable system of air-chambers connected with the trachea. This specimen contributes a couple of minor details to the description. The cartilaginous portion of the *trachea* is U-shaped, with the interrupted ends to the right. The *tracheal membrane* begins close to the glottis and runs along the right side as far as the 16th gastrostege; at this point it is tense, parallel to the sagittal plane, and 6·5 mm. wide. The transverse diameter of the trachea is also 6·5 mm. at this point. The air-chambers are to the right of the trachea. The first compartment is 55 mm. long and reaches from the level of the 2nd gastrostege to the 11th g.; it has one foramen, 1·7 mm. in diameter, at the 6th g., and another, 2·7 mm. in diameter; these are situated on the tracheal membrane and communicate with the lumen of the windpipe. The second compartment, 12 mm. long, extends from the 11th g. to the 13th g.; it has one foramen, 1·3 mm. in diameter, near the posterior wall. At the middle of this chamber there is an oval thin spot on the tracheal membrane. These thin spots have been observed and referred to by Dr. Beddard as "imperforate foramina." The third compartment, 9·5 mm. long, extends from the 13th to the 15th g.; near the anterior wall is a foramen 2·3 mm. in diameter, and near the posterior wall an imperforate foramen.

The only other serpents known to possess a similar system of air-chambers are *Pseudoxenodon chinensis* and *Coluber oxycephalus*. The latter has in addition one of the longest right lungs recorded in a Colubrine. To complete the data for the Hamadryad it is necessary to ascertain the distance the anangious portion of the right lung enters the cœlum. In the ordinary museum specimen this is not easy to determine. A useful procedure is to suspend the specimen and to inject into the trachea a little 95 per cent. alcohol, tinged with eosin, and allow it to trickle down into the lung. With the least bit of luck the fluid will reach quite to the end and stain the lung, so that it stands out in fair contrast. The main point in the technique is to employ an extremely weak staining solution.

DOLIOPHIS BIVIRGATUS Boie.

Specimen.—California Acad. Sci. No. 33059. Sarawak, Borneo. Adult male: total length 1319, tail 128 mm.

The *tracheal membrane* in this species is of large dimension.

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* P. Z. S. 1903, vol. ii. p. 319.

It begins at the glottis and rapidly widens to comprise 50 per cent. of the circumference of the tube; at the 42nd gastrostege it has increased in width to 66 per cent., and just before the heart it is fully 80 per cent. The cartilaginous rings are markedly thin and weak; towards the end of the trachea they lie along the dorsal and left segment of the tube. The *trachea* for its entire length is destitute of air-cells. It gives every indication of filing all the available space along its course. There is no line of demarcation to show where it ends and the lung begins. The alveolar tissue of the *left lung* is thin; it begins very gradually at about the level of the auriculo-ventricular septum, and continues to the 116th g.; from this point to the 128th g. there are a few large irregular air-cells before the anangious portion begins. There is no *free apex* and no rudimentary *left lung.* The *heart apex* is at the 91st g., and the tip of the *liver* at the 101st. *Gastrosteges* 272. There are 13 rows of *scales* from the neck to the level of the 265th g.; at this point the median row is suppressed, leaving 12 rows.

Causus rhombeatus Lichtenstein.

Specimen.—Brit. Mus. Nat. Hist. Ex. No. '13–11 *a.* Fort Hall, British East Africa. Adult male.

The *trachea* increases in diameter and occupies a large part of the cervical region; its walls are almost entirely formed by the membrane. The *tracheal membrane* begins on the left side at the level of the glottis; it rapidly widens, and after a few millimetres becomes lined with pulmonary tissue which in no respect differs from that found in a normal lung.

The *cartilaginous portion* at the origin almost surrounds the tube, being incomplete only on the left; at the 12th gastrostege it becomes ventral and forms a small U-shaped gutter, 1·5 mm. in diameter; as it approaches the heart it gradually flattens out and is continued onto the anangious portion as a band. This *intrapulmonary bronchus* ends at the 65th g.; it is not a mere strip of fibrous tissue but a flat band of similar structure to the tracheal wall, with the alternate sections of cartilage and connecting membrane. The *right lung* has a very scanty lining of pulmonary tissue; thickly-set air-cells cease on the ventral surface of the tracheal membrane at the 32nd g., dorsally they are continued a little further; from this on to the heart apex there are large oblong cells extending along each side of the tracheal band; on the lateral walls of the lung these alter to an irregular shallow honeycomb structure; posterior to the heart apex the lung is a simple air-sac, with the remnant of the bronchus along its ventral wall. The *left lung* is completely suppressed.

The *heart* is situated principally to the right of the median line; it is rotated on its long axis until the right auricle is nearly dorsal to the left.

The *pulmonary artery* divides 3 mm. from its origin into pulmonary and tracheal branches. The pulmonary branch is much the smaller; it runs along the left lung, at first to the left, then down the centre of the bronchial band. The tracheal branch runs anteriorly along the tracheal membrane.

The first portion of the descending limb of the *left aortic arch* lies to the right of the left ventricle; this would be equivalent to lying on the ventral surface of the heart were that organ not rotated. The left aorta crosses to the left side ventrad to the space between the heart apex and the liver tip; it then winds around the œsophagus at the 46th g. and continues closely adherent to and beneath the lung just to the left of the bronchial band. The few *intercostal* arteries noted enter in the mid-dorsal line. There is a single *spermatic artery* on each side. There are nine right and ten left *renal arteries*: these are short and enter directly. The *liver* is situated almost entirely to the right of the median line; like the heart it also is rotated on its long axis; the right lobe is dorsal to the left and posteriorly is 3·5 mm. longer. The *hepatic duct* joins the cystic duct at the 85th g. and the common duct enters the ventral surface of the pancreas. The parietal *peritoneum* is greyish-brown; the visceral coverings are but slightly tinged with the exception of that on the testis which is very dark.

The *external landmarks* of the principal viscera in terms of gastrosteges are as follows:—

Gastrosteges	145	100 per cent.
Heart apex	42	29
Liver, tip	41	28·3
,, end	72	49·7
Gall-bladder	83	57·3
Testis, right, tip	95	65·6
,, ,, end	100	69
,, left, tip	105	72·5
,, ,, end	109	75·2
Kidney, right, tip	108	74·5
,, ,, end	138	95·2
,, left, tip	116	80
,, ,, end	139	95·9

The *scales* are in 19 rows anteriorly, decreasing to 17 and finally to 15 rows posteriorly. *Gastrosteges* 145.